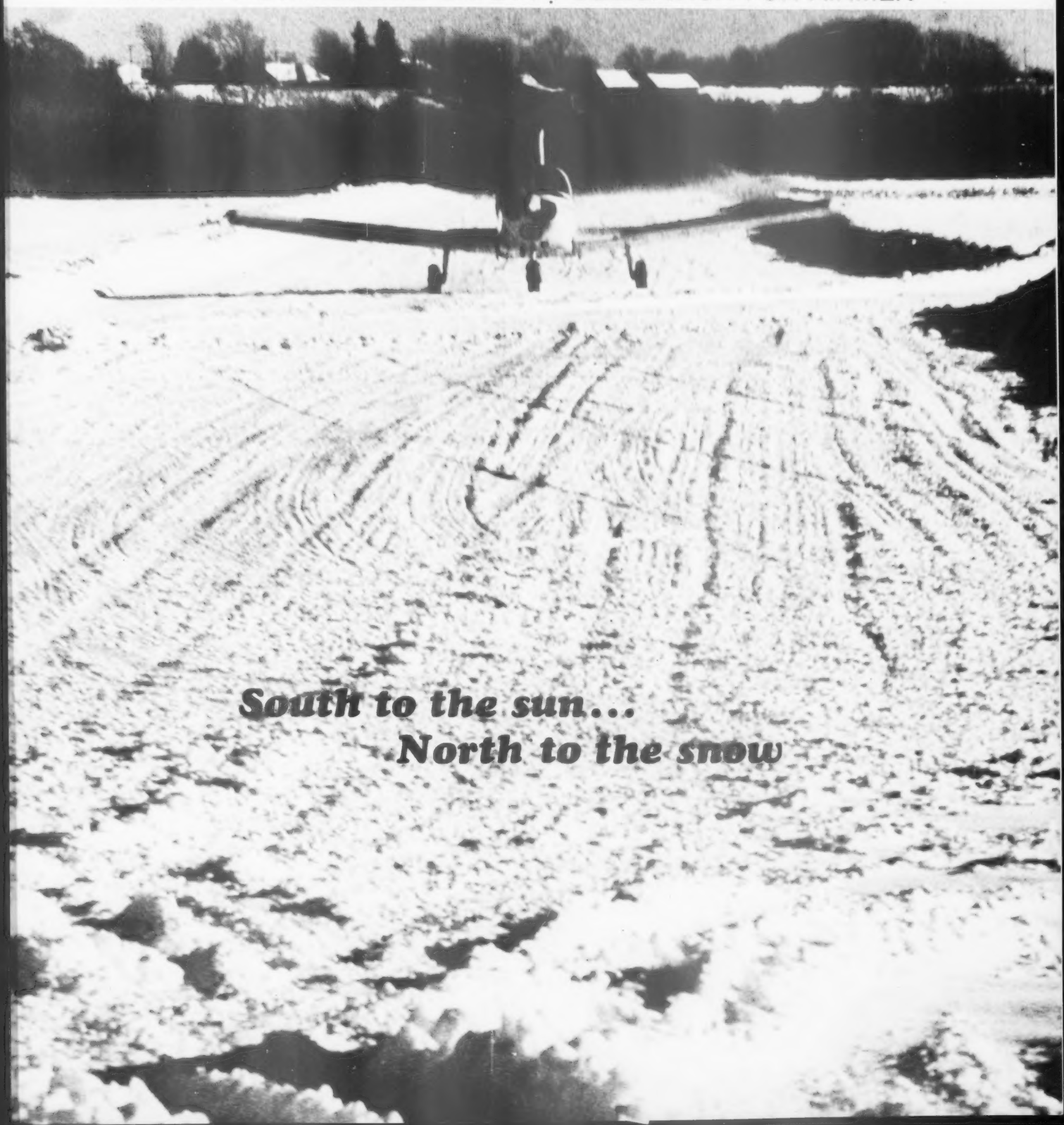
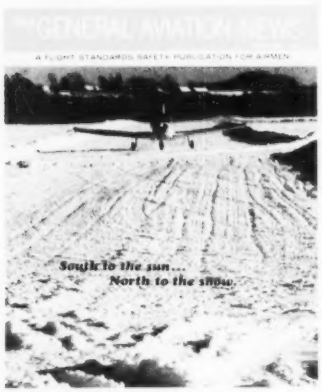
# FAA GENERAL AVIATION NEWS

FEBRUARY 1977

A FLIGHT STANDARDS SAFETY PUBLICATION FOR AIRMEN






**COVER:**

Waterbury (Conn.) Airport in the grip of winter.
*Photo by Elizabeth Joy.*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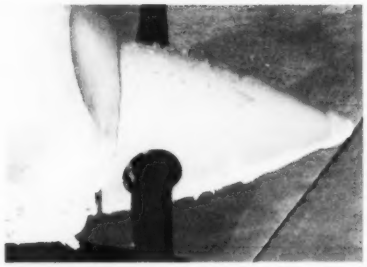

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# GREEN DEMONS AND GREY PHANTOMS

***Visions of military fighters whizzing by your window at low altitude may not be illusions***

The pilot was by his own admission a "careful man" who did not like any surprises when he was flying, especially when he had his family aboard. On this occasion, when he was flying his wife and two young sons on a visit to her parent's farm in southern Tennessee, he had checked the weather carefully and filed a flight plan, even though it was a journey of less than a hundred miles over countryside he knew as well as the back of his hand. He had also taken the trouble to make certain his sectional chart was current, and he had, as usual, meticulously preflighted the airplane and was certain that all was in order on that mild, sunny, winter's day when they flew leisurely down country.

Nevertheless, as he was banking the aircraft in preparation to making his approach to land at the farm's grass strip, he got the surprise of his life when he caught sight of a military jet, bristling with armament, shoot past under his upraised wing. His children shrieked, his wife gaped, horrified, and he himself had his hands full for the next several minutes coping with the ensuing turbulence—which mercifully allowed him to put off answering the barrage of questions from the back seat about, "What was the jet doing so low over the farm?"

He just did not know the answer, and he had to remain in troubled ignorance for the next several days, until he got back to his home field and checked with the flight service station. There he learned that Grandfather's farm lay directly under the flight path of an officially designated Low Altitude Training Route for the Air Force. The aircraft that had passed so close under his wing was a supersonic *Phantom* on a ground-hugging exercise flown at near the speed of sound. *How was the civilian pilot supposed to know about, let alone see and avoid, such traffic?* The more he learned about the incident, the more incensed he became.

The question is one which should concern every pilot who flies VFR at low altitudes, either for business or pleasure. There are 277 such low altitude military training routes scattered over the United States, covering some 30,000 linear miles, potentially active whenever VFR conditions prevail. They are flown as close to the terrain as possible, as an exercise in avoiding radar detection, usually between 500 and

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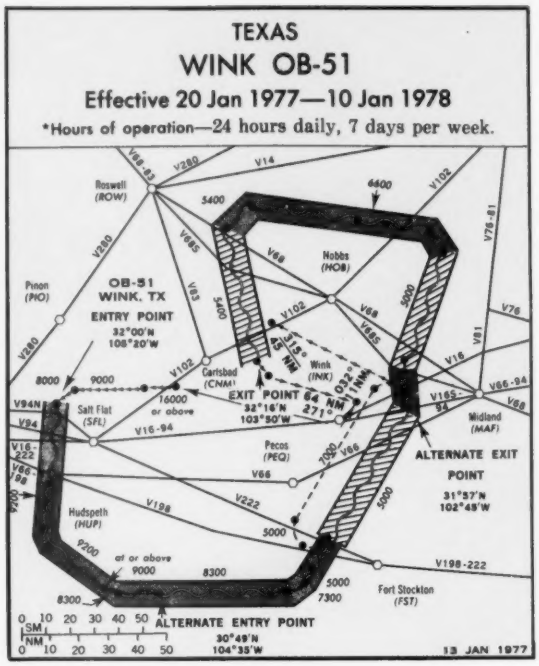
"Olive Branch" route as depicted in AIM Part 4. Wavy line shows terrain following course.




Military "green demon" chart shows VFR low-altitude routes criss-crossing California terrain west of Los Angeles. These charts are published every 84 days and route changes, if any, are made at that time.

Military pilots will notify FAA flight service stations 30 minutes before takeoff or, if airfiling, 10 minutes prior to route entry.

1500 feet above ground level, at speeds ranging from 300 to 550 mph. Civilian air traffic below 10,000 feet is restricted to a maximum airspeed of 250 knots, which is intended to allow pilots sufficient time to identify possible traffic conflicts and avoid them. But if the potential hazard is a head-on collision involving a near-sonic military fighter, the closing speed is such that the pilot may have less than five seconds for each mile of separation to recognize the danger, determine appropriate evasive action and carry it out. That is very little time, even for a professionally trained pilot.

Fortunately, in recent years there have been no midair collisions between civilian aircraft and *low-flying* military aircraft, but the numerous reports of near-midairs reported to FAA suggest that civilian ignorance of the presence of training routes virtually in their own backyard constitutes a potential invitation to disaster. During the less-than-four-year period from 1973 through September of 1976, more than 300 reports of civilian/military near-midair accidents were filed with, and investigated by, FAA. Of these, 191 were classed as "potential hazards," and 44 were classed as "critical." Some of the reports originated with the general aviation pilot, some with the military, others with both. In almost every case, one or both pilots expressed great surprise at finding another airplane at such close proximity with his own.

An incident of this kind occurred not long ago over the Mississippi River about 60 miles southeast of Minneapolis. The pilot of a Piper *Twin Comanche* was on a heading of approximately 300 degrees, flying at 2,500 MSL (about 1,000 feet over the ground) without a cloud or another airplane in the sky around him—as far as he could see. Just happening to look to his left, he suddenly spotted an Air Force F-100 *Super Sabre* jet at his 9 o'clock position, coming directly at him and apparently only about 200 yards away. Since he had an impression the military aircraft was slightly below him, he instinctively pulled back on the yoke. The jet passed under his left wing at a distance estimated as "less than 50 feet." Luckily, the Air Force pilot had perceived the *Comanche* a half-second earlier, and had initiated a dive.

In this case, typically, the civilian pilot was dumbfounded to learn that he had unknowingly flown directly across an established and "hot" (in use) low altitude military VFR training route, at the active level of 1,000 feet above the ground.

Another type of military operation that general aviation pilots should be aware of is that conducted on "All Weather Low Altitude Training Routes" (code-named "Olive Branch Routes" and formerly called "Oil Burner Routes").

The Olive Branch routes are used for low-level navigation/bombing practice. The Airman's Information Manual (AIM) Part 4 shows the location of current Olive Branch Routes (23 at latest count, sprinkled variously across the country) and also contains diagrams of each route, with a detailed description of the operations conducted thereon and also the hours of possible use. Olive Branch flights are carried out in both VFR and IFR weather on established altitudes (included in AIM).

Additionally, when the weather conditions provide at least a 3,000-foot ceiling and five-mile visibility, aircraft may fly Olive Branch routes from those altitudes all the way to the surface. The nearest FSS will know if a route is "hot" at any given time.

The location of these military routes is not shown on sectionals or any other civilian charts. Concerned pilots should either acquire a military area planning FLIP chart (Flight Information Publication) for their area, or examine one at an FSS or airport office. There is an East, West and Central chart for North America, costing $1.75 each. The entire set of charts, together with a book that explains these operations, is available on a subscription basis (charts are re-issued every 84 days) for $20.70 per year. Order from the National Ocean Survey, Distribution Division C-44, Riverdale, MD 20840, specifying "DOD Flight Information Publication—Area Planning, Military Routes North and South America AP/1B".

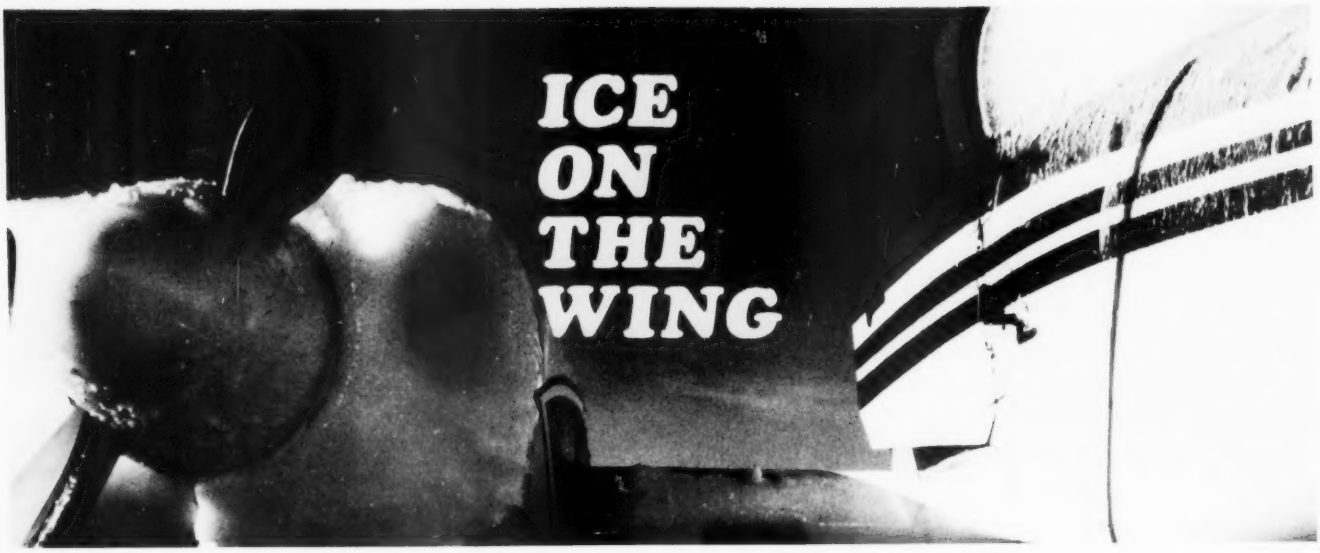
Pilots who are engaged in aerial application, pipeline patrol, forestry work, rescue operations, etc., as well as others who for individual reasons do considerable flying at low altitudes, can protect themselves by becoming familiar with the location of any such military routes in their vicinity, if any, and by taking the trouble to check with the FSS before flying across them. However notice of the mission given by the military pilot to the FSS may be fairly short, perhaps less than half-hour, so precise hourly periods of use may not be ascertainable.

An awareness of these routes and their utilization is not a cause for alarm to general aviation pilots; it is simply a matter of being prepared for what might be encountered by being forewarned. There is an inclination on the part of some civilian pilots to assume that with the end of the last war the need to be on the alert for possible conflict with military training flights has disappeared. The truth is that a considerable amount of military air training goes on constantly, year in and year out, in time of peace or war; safe usage of the airspace demands an understanding of how and where such flights are made.

*(Part two of this article, which will appear in the next issue, deals with Restricted, Prohibited and Military Operations Areas.)*

Briefer at Jacksonville, Fla. FSS shows a student where to expect military activity.

T-37 jet, "loaded for bear" in low-level practice run, skimming the treetops.



# ICE ON THE WING

lying south to the sun—a favorite wintertime project for many pilots—is apt to involve a very much different set of circumstances from those experienced on the return trip, flying back to the frozen north. The distance is the same, the course and NAVAIDS may be identical (in reverse) but the presence of winter weather in the north can extend the flight and even imperceptibly reduce the operating efficiency of the aircraft. One of the factors which can bring about this reduced efficiency is *structural*, or *surface icing* which can result in a much higher fuel consumption than expected—as much as 50% higher, in extreme cases.

Icing, like the proverbial Will O' the Wisp, is where you find it. Weather forecasters can identify regions in which icing is possible, but they cannot define exact localities or altitudes. For ice to build up on an airplane in flight, two conditions are necessary: you must be flying through visible moisture such as rain or clouds; and the air temperature must be at the freezing point or lower. If you stay out of clouds when temperatures are near the freezing point, you can stay free of ice. Cumulus clouds are especially notorious for icing; in frontal systems there is warmer air at higher altitudes, but a heavy burden of ice may make it impossible to climb sufficiently high to reach warm air.

Icing may occur at any season, but in the United States it is most prevalent and most dangerous in the winter. At this time the freezing level is closer to the ground, resulting in a smaller low-level layer of airspace free of icing conditions. Icing is most probable and most hazardous over mountains, where rapid upward air movement (on the windward side) supports large water drops. The icing zone may extend upwards for 5,000 feet or more above the crests.

Icing is frequently accumulated during an IFR approach through clouds. In these circumstances the pilot should anticipate the fact that his aircraft may stall at a higher than normal speed, avoid abrupt changes of attitude, and carry more power through the landing maneuver.

Ice can cripple an aircraft in a flight in a myriad of different ways. Probably the most common area of buildup is at the leading edge of the wing, which distorts the camber of the wing (reducing lift and increasing drag) and redistributes the weight on the wings. Ice buildup can be massive enough to exceed the gross maximum permitted weight of the airplane, leading to changes in flight characteristics and possibly to loss of control. Ice can also form on sensitive control surfaces and cause vibrations (this is also true of the propeller) that literally shake the aircraft apart. Control hinges may be jammed by ice formations, and landing gear mechanisms can be jammed in place. Radio and radar antennas can be so distorted by ice as to be rendered unreliable or nonfunctioning—which means that when you need help most you may be isolated in radio silence. Inflight surface icing is, in a word, a very potent killer of airmen.

Failure to anticipate the aerodynamic effect of inflight icing led to the unhappy ending of a winter holiday in Florida last year, in an accident typical of these conditions:

The pilot was a 47-year-old business executive, the owner of a small computer firm in Erie, Pa. He had been flying for eight years, and by the time of his accident he had logged 910 hours and held a multiengine and instrument ratings.

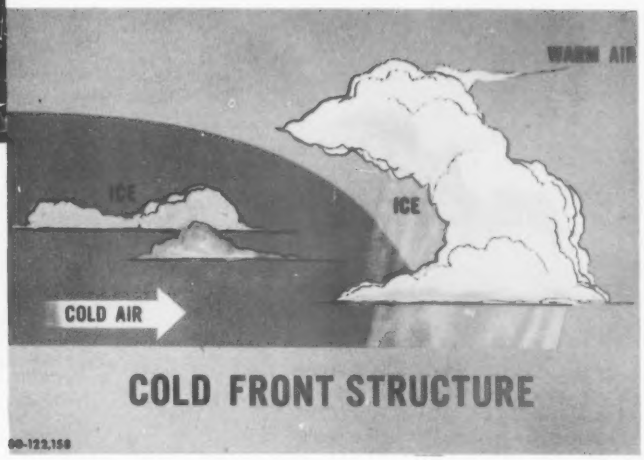
The purpose of his flight was a winter vacation, a week of sun and golf for himself and his wife in West Palm Beach, Fla. For the flight he rented a "push and pull" twin *Skymaster* (Cessna 337).

Heading south, they flew from Erie to Atlanta, a distance of some 625 miles, in 3 hours and 45 minutes. They stayed overnight with relatives, and proceeded on to West Palm the next day, a flight of some 550 miles. The *Skymaster*'s stated optimum range was 965 miles at 10,000 feet with 75% power, and 760 miles at 5,500 feet with 75% power. The fuel gauges showed an ample reserve.

The trip home a week later in different weather conditions, however, was a totally different story.

The flight from West Palm to Atlanta was VFR, but after their overnight stay the pilot and his wife discovered that the weather to

The nose-up position of this **Skymaster,** which had been parked out in a snowstorm, clearly shows the effect that snow and ice can have on the balance of an airplane.




**Above**—in a cold front (or a warm front) there is warmer air above the icing layer—but with a distorted airfoil you may not have enough power to get there. **Right**—photo shows rime ice forming on wing tip.

the north was deteriorating. They checked with the FSS at Atlanta, and decided to wait out the morning for better conditions.

When the pilot checked again at noon he found that a cold front was moving down from Canada through western Pennsylvania, eastern Ohio, and West Virginia, causing IFR weather all along his route and at his terminal point. *En route ceilings were below 1,000 feet, with 3 miles visibility in stratus, fog and occasional light snow or light freezing rain. Reported tops 6,000 to 8,000. Icing: moderate rime ice or mixed ice in clouds and in precipitation above the freezing level.*

The noon report at Erie was *ceiling measured 1,200 feet overcast, visibility four miles, fog, temperature 26 F., wind 260 degrees, eight knots.* Those conditions were not expected to improve appreciably for the next eight hours.

Despite his wife's misgivings, the pilot decided to go on. He had business the next day in Erie, and their vacation period was over. He had an instrument rating, he felt confident with the airplane, and he had flown the Erie-Atlanta segment just a week ago. He would top his tanks, get up to 9,000 feet, fly over the weather as much as possible and then make an instrument approach at Erie if conditions worsened there.

He filed an IFR flight plan to Erie International, giving as his estimated time en route 3 hours and 45 minutes, (based on the earlier flight south) and stating that he had six hours of fuel on board.

They departed Atlanta at 1:07 that afternoon, heading north into increasingly cloudy skies. At 9,000 feet, they were on the edge of the clouds most of the time, and as they crossed over the Smoky Mountains the pilot had the impression he was picking up ice on the wings and tail. He checked with the FSS at Knoxville and again at TriCity for pilot reports of icing along his route.

He used the same fuel management techniques as on the flight down, running on his main tanks for the first hour, then switching to the auxiliaries. Once again he switched back to the main tanks when he estimated the aux tanks were nearly dry. He was not certain he had managed to dissipate all the ice he had picked up on climbout, and asked Air Traffic Control if a higher altitude was available, but then decided not to climb higher because he had no oxygen aboard and his wife suffered from mild hypertension.

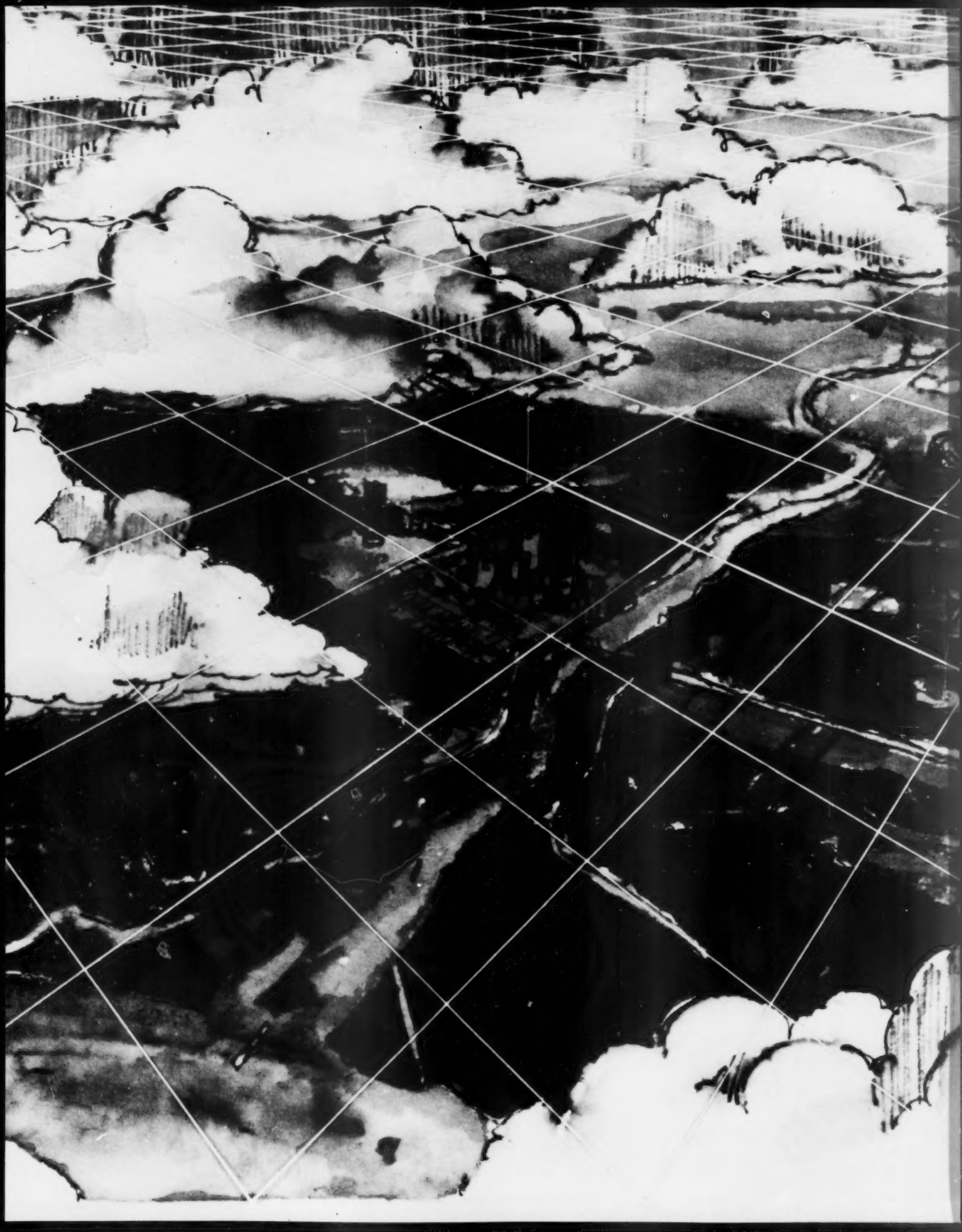
At 5:00 p.m., when they were expected on the ground at Erie, they were just passing over Pittsburgh, 100 miles to the south. The pilot discussed an alternate landing here with the controller. Pittsburgh was then reporting a 1,500 foot ceiling and two miles visibility. The pilot decided he would continue on to Erie where he was familiar with the IFR approach. He estimated he had at "least two hours of fuel remaining." He sounded quite competent, and informed the controller they had "promised the kids some tree-ripened oranges for breakfast."

An hour later the *Skymaster* was turned over to Erie Approach Control and the pilot began his letdown for the localizer approach. After some confusion the pilot realized that he was not receiving the localizer signal—he assumed that his antenna was iced over—and he had to be vectored onto the course. It was pitch dark by this time.

Approximately two miles from the runway the pilot reported he was losing power —". . . rear engine quit, out of gas I guess . . . ." This was his last communication. Witnesses on the ground at the lakeshore saw the aircraft, apparently in a stalled condition, with one engine roaring at full throttle, spiraling down. The plane hit the ice covered lake at a fairly steep angle, broke through the ice and partially submerged nose-down in shallow water. No one survived.

Investigators at the scene the next morning found a heavy accumulation of ice still on the wing booms and the horizontal stabilizer. There was no evidence of mechanical failure but the main tank for the rear engine was virtually dry, indicating fuel starvation had stopped the engine, resulting in a stall before sufficient power could be added to maintain control of the airplane.

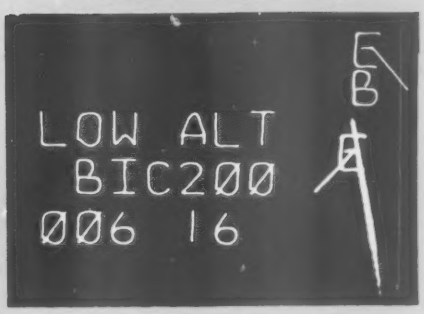
*(Note: Certain details of this naration have been altered to preserve anonymity.)*



# THE CAPTURE BOX

*A radar add-on that warns of dangerously low altitudes*

For MSAW purposes the local terrain is divided into two-mile squares and the highest point in each grid is programmed into the warning system.




MSAW quickly focuses controllers attention on dangerously low altitude position of aircraft with altitude encoding transponders.

When altitude is projected to be less than 300 feet above terrain, an aural alarm sounds and "LOW ALT" appears on the radar scope.

The radar safety advisory program, used by FAA's air traffic service to help pilots avoid flying into the ground or into terrain obstacles, is being improved at 63 major terminal control facilities with the addition of an automated alerting device known as MSAW.

MSAW, for Minimum Safe Altitude Warning, involves computerized tracking of aircraft and continuous comparing of their position with the predetermined safe altitude for a given area. Whenever the aircraft descends below that altitude, or is projected to do so—should the current flight path continue—the words "LOW ALT." flash on the radarscope over the data-tag for that aircraft, and a warning buzzer is sounded. The controller immediately assesses the situation and, if necessary, radios a warning to the pilot: "LOW ALTITUDE ALERT. CHECK YOUR ALTITUDE IMMEDIATELY."

The MSAW alerting system, where installed will be applied routinely for all IFR aircraft with an altitude encoding transponder when they are tracked by the terminal air traffic control computer. VFR aircraft pilots may also take advantage of this service, if their aircraft has a functioning altitude encoding transponder, by asking the controller for "MSAW."

MSAW accomplishes two functions: general terrain monitoring (which includes local flying and aircraft transiting the terminal area), and airport approach path monitoring.

For general terrain monitoring, MSAW's computer uses a three-dimensional grid map. Each grid is four square miles and is assigned the altitude of the highest terrain or obstruction with the grid. On the basis of information derived from the aircraft's transponder, the computer is able to issue a warning before the aircraft descends to a predetermined safe height above this altitude.

The second function, approach path monitoring, takes over as the aircraft makes its approach to land at a terminal which has the service. The monitoring is done over a rectangular area, called a "Capture Box," approximately two miles wide commencing about five miles from the runway and ending about two miles out. An MSAW alert is given if the aircraft descends more than 100 feet below the Minimum Descent Altitude (MDA) for this approach, or is pro-

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General terrain monitoring service of MSAW considers three factors: the aircraft's current altitude; the predicted altitude for the next 30 seconds; the projected altitude for the next eight minutes.

jected to descend 200 feet or more below the MDA within the next 15 seconds. This monitoring function ceases about two miles from the runway threshold. In the case of aircraft approaching to land on a non-instrument runway, the general terrain monitoring service is used, and terminated approximately three miles from the airport.

MSAW service is offered within the scope approach control area of an airport equipped with an FAA Automated Radar Terminal System (ARTs III)—usually extending from 30 to 40 miles out from the airport. Inbound or transiting VFR pilots should request the service, if desired, from Approach Control before they penetrate the approach control area, in order to allow time for appropriate data to be assimilated.

Pilots are reminded that MSAW, like all electronic devices, is subject to failure or interference, which under a variety of circumstances could result in *no alert being provided the controller*. Additionally, since the computer needs about 10 seconds to establish a definite course or altitude change, an alert may be sounded too late for corrective action if a very abrupt, rapid turn is made toward an obstruction in an adjacent grid, or a very abrupt descent is begun at low altitude over an obstacle. As a rule MSAW, where in service, will contribute to the safety of flight; but it must not be thought of as an automatic guarantee of terrain clearance. The primary responsibility for maintaining a safe altitude still belongs to the pilot.

Controllers at Dulles and Los Angeles International Airports are already using MSAW. It is expected to be in use at 61 additional airports by midsummer.

PLANNED MSAW LOCATIONS

Albany
Albuquerque
Atlanta
Baltimore
Birmingham
Boston
Buffalo
Burbank
Cairns, Ala. (Ft. Rucker)
Charlotte
Chicago
Cincinnati
Cleveland
Columbus
Dallas
Dayton
Denver
Des Moines
Detroit
El Paso
Hartford
Honolulu
Houston
Indianapolis
Jacksonville
Kansas City
Las Vegas
Louisville
Memphis
Miami
Milwaukee
Minneapolis
Nashville
New Orleans
Norfolk
Oakland
Oklahoma City
Omaha
Ontario
Orlando
Philadelphia
Phoenix
Pittsburgh
Portland
Providence
Raleigh
Rochester
Sacramento
St. Louis
Salt Lake City
San Antonio
San Diego
San Juan
Santa Ana
Seattle
Shreveport
Syracuse
Tampa
Tucson
Tulsa
Washington-National (Wash. D.C.)

# Chuck Yeager and the BRICK WALL IN THE SKY

*The "boom" that broke open the path to the stars*

Supersonic flight is currently embroiled in questions of an environmental and economic nature, but the feasibility of flying at speeds far beyond the speed of sound was proven beyond question a quarter of a century ago by a young pilot from the hills of West Virginia, the first man in history to "break through the sound barrier."

Toward the close of World War II many aircraft had approached the speed of sound, only to be turned back by violent buffeting and loss of control. Aerodynamic scientists were thoroughly confused over the phenomena of supersonic flight, so much so that the concept of a physical barrier limiting the speed of movement through the air was widely supported.

The speed of sound, about 760 mph at sea level on a standard day, was first calculated accurately by the Austrian scientist Ernst Mach at the turn of the century. The modern sensing instrument, the Machometer, is named after him. The machometer measures subsonic speeds as percentages of Mach 1 (the speed of sound at any given altitude and temperature), such as Mach .82, or Mach .94, etc. Supersonic speeds are read as percentages in excess of Mach 1 (1.25, 2.50, 3.0, etc.).

It was known that an aircraft at high speeds compresses and pushes air ahead of it, in the form of sound waves of energy. It was also understood that as an aircraft approaches the speed of sound, these advance pressure waves are further compressed and "bunch up" to form a "shock wave." The shock wave was thought of as a "sound barrier" because it was believed to cause such fierce and freakish turbulence as to render the aircraft's control surfaces ineffective or even, by twisting airfoils, bring about a reversal of control. These phenomena were not imaginary. The test pilot son of the famous British aircraft designer, Geoffrey de Havilland, was killed when an experimental DH-106 "Swallow" disintegrated at near sonic speed in June of 1945.

At this time the U.S. Air Force began testing a "bullet with wings," a rocket-powered aircraft designed to penetrate the sound barrier, known as the Bell Aircraft XS-1. Program managers had their choice of a number of extremely fine test pilots, including the famous (and still amazing) Bob Hoover. But the man they selected was Captain Charles E. Yeager, a 24-year-old ex-fighter pilot whose record suggested an unusual combination of native mechanical ingenuity and rock-like durability.

Chuck Yeager was born in 1923 at Hamlin (pop. 600), W. Va., and passed an uneventful boyhood in that quiet coal and gas mining community where his father was a driller. His parents offered to help him enter college, but Chuck, who generally liked to do things on his own, already had his eyes on broader horizons. With the outbreak of World War II he enlisted in the Air Corps as a private, trained as a mechanic, qualified as a "flying sergeant," received a battlefield commission, and soon built himself a reputation as a premier fighter pilot.

His career was interrupted in 1944 when his P-51 was shot down over occupied France. Yeager was "evaded" through enemy lines by French partisans in a drawn-out three month adventure that culminated in a Spanish jail—and eventual release. He returned to the air battle with renewed vigor, and was soon acclaimed for shooting down five ME-109s on a single escort mission. By war's end he had flown 61 missions, shot down 13 enemy aircraft, and received a score of medals, including the Distinguished Flying Cross. He came home in 1945 to marry a glamorous Californian named Glennis Dickhouse, and retrained as a military test pilot.

The unusual aircraft he was selected to test in 1947, the X-1, had a bullet-shaped fuselage because this was one configuration known to penetrate the supersonic range with apparent impunity. It was sheathed with a conventional aluminum alloy, but given a structural strength capable of withstanding 18 G's—far more than the body of any pilot could tolerate. There was also a slender, tapering midwing and a fairly conventional tail. The X-1 had a retractable landing gear, but from the beginning it was planned for a launch at altitude from a "mother plane," since the four-burner rocket engine could burn for only 2.5 minutes at full power. It was designed for a power-off, fuel-evacuated landing.

The airplane weighed about 6,800 lbs. empty but carried more than its own weight in fuel—a mixture of liquid oxygen, water and alcohol. Compressed nitrogen was used

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General terrain monitoring service of MSAW considers three factors: the aircraft's current altitude; the predicted altitude for the next 30 seconds; the projected altitude for the next eight minutes.

jected to descend 200 feet or more below the MDA within the next 15 seconds. This monitoring function ceases about two miles from the runway threshold. In the case of aircraft approaching to land on a non-instrument runway, the general terrain monitoring service is used, and terminated approximately three miles from the airport.

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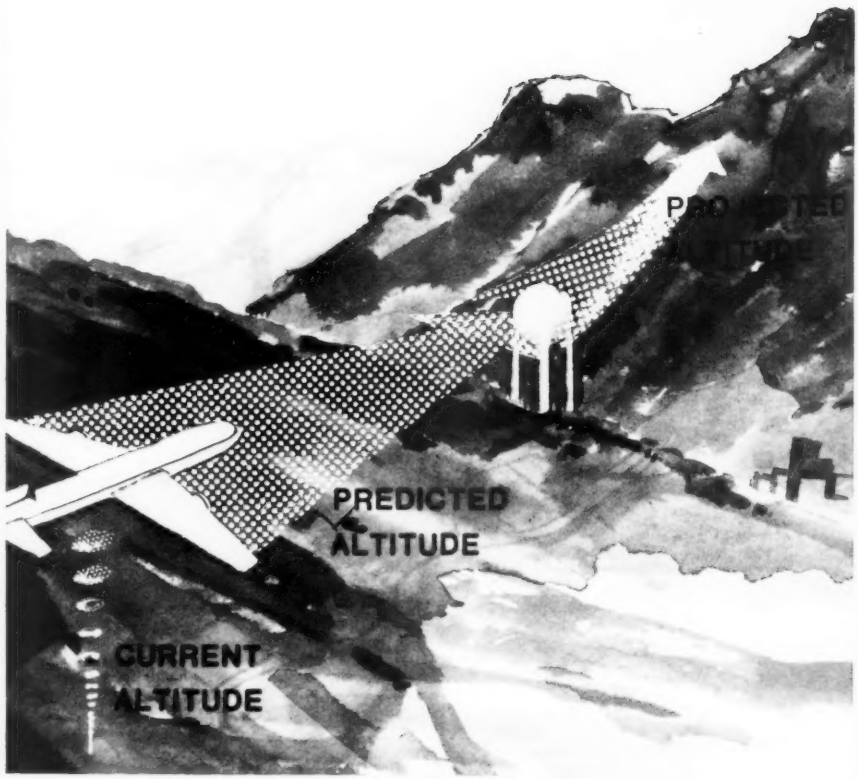
Pilots are reminded that MSAW, like all electronic devices, is subject to failure or interference, which under a variety of circumstances could result in *no alert being provided the controller*. Additionally, since the computer needs about 10 seconds to establish a definite course or altitude change, an alert may be sounded too late for corrective action if a very abrupt, rapid turn is made toward an obstruction in an adjacent grid, or a very abrupt descent is begun at low altitude over an obstacle. As a rule MSAW, where in service, will contribute to the safety of flight; but it must not be thought of as an automatic guarantee of terrain clearance. The primary responsibility for maintaining a safe altitude still belongs to the pilot.

Controllers at Dulles and Los Angeles International Airports are already using MSAW. It is expected to be in use at 61 additional airports by midsummer.

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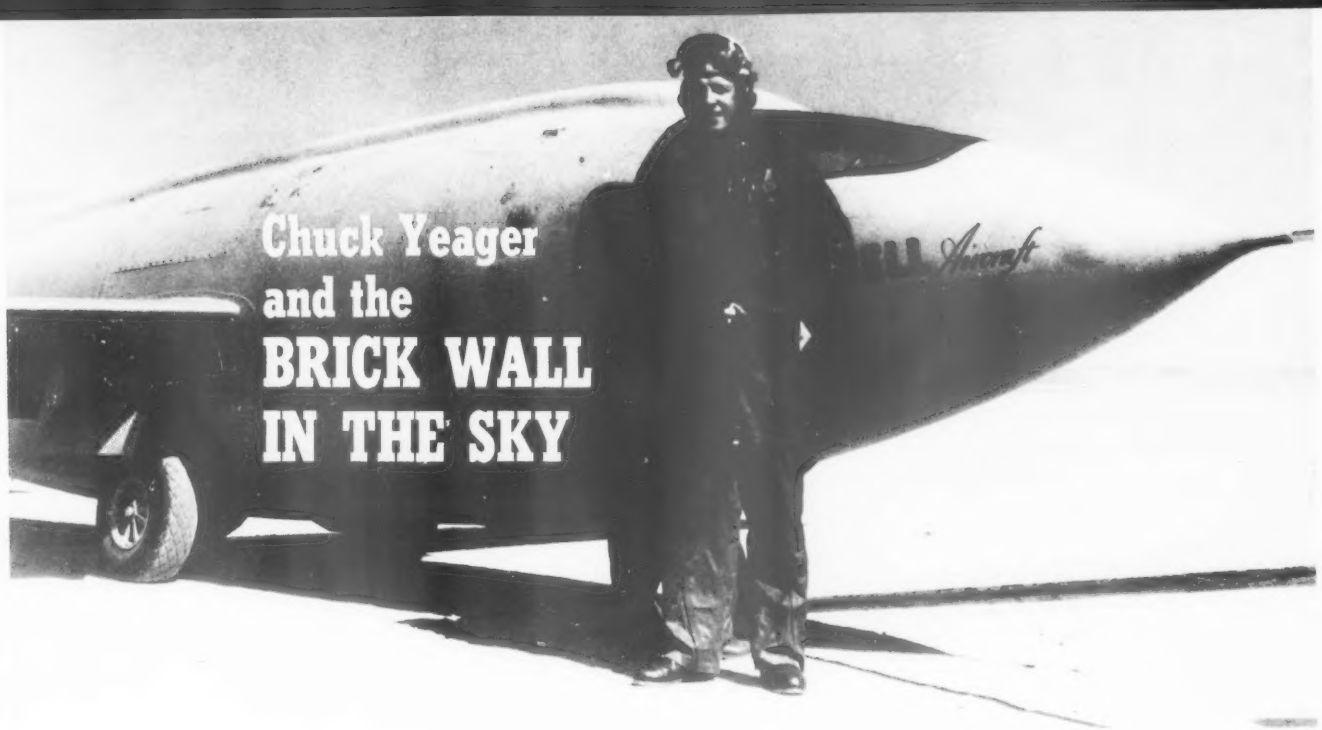

# Chuck Yeager and the BRICK WALL IN THE SKY

*The "boom" that broke open the path to the stars*

upersonic flight is currently embroiled in questions of an environmental and economic nature, but the feasibility of flying at speeds far beyond the speed of sound was proven beyond question a quarter of a century ago by a young pilot from the hills of West Virginia, the first man in history to "break through the sound barrier."

Toward the close of World War II many aircraft had approached the speed of sound, only to be turned back by violent buffeting and loss of control. Aerodynamic scientists were thoroughly confused over the phenomena of supersonic flight, so much so that the concept of a physical barrier limiting the speed of movement through the air was widely supported.

The speed of sound, about 760 mph at sea level on a standard day, was first calculated accurately by the Austrian scientist Ernst Mach at the turn of the century. The modern sensing instrument, the Machometer, is named after him. The machometer measures subsonic speeds as percentages of Mach 1 (the speed of sound at any given altitude and temperature), such as Mach .82, or Mach .94, etc. Supersonic speeds are read as percentages in excess of Mach 1 (1.25, 2.50, 3.0, etc.).

It was known that an aircraft at high speeds compresses and pushes air ahead of it, in the form of sound waves of energy. It was also understood that as an aircraft approaches the speed of sound, these advance pressure waves are further compressed and "bunch up" to form a "shock wave." The shock wave was thought of as a "sound barrier" because it was believed to cause such fierce and freakish turbulence as to render the aircraft's control surfaces ineffective or even, by twisting airfoils, bring about a reversal of control. These phenomena were not imaginary. The test pilot son of the famous British aircraft designer, Geoffrey de Havilland, was killed when an experimental DH-106 "Swallow" disintegrated at near sonic speed in June of 1945.

At this time the U.S. Air Force began testing a "bullet with wings," a rocket-powered aircraft designed to penetrate the sound barrier, known as the Bell Aircraft XS-1. Program managers had their choice of a number of extremely fine test pilots, including the famous (and still amazing) Bob Hoover. But the man they selected was Captain Charles E. Yeager, a 24-year-old ex-fighter pilot whose record suggested an unusual combination of native mechanical ingenuity and rock-like durability.

Chuck Yeager was born in 1923 at Hamlin (pop. 600), W. Va., and passed an uneventful boyhood in that quiet coal and gas mining community where his father was a driller. His parents offered to help him enter college, but Chuck, who generally liked to do things on his own, already had his eyes on broader horizons. With the outbreak of World War II he enlisted in the Air Corps as a private, trained as a mechanic, qualified as a "flying sergeant," received a battlefield commission, and soon built himself a reputation as a premier fighter pilot.

His career was interrupted in 1944 when his P-51 was shot down over occupied France. Yeager was "evaded" through enemy lines by French partisans in a drawn-out three month adventure that culminated in a Spanish jail—and eventual release. He returned to the air battle with renewed vigor, and was soon acclaimed for shooting down five ME-109s on a single escort mission. By war's end he had flown 61 missions, shot down 13 enemy aircraft, and received a score of medals, including the Distinguished Flying Cross. He came home in 1945 to marry a glamorous Californian named Glennis Dickhouse, and retrained as a military test pilot.

The unusual aircraft he was selected to test in 1947, the X-1, had a bullet-shaped fuselage because this was one configuration known to penetrate the supersonic range with apparent impunity. It was sheathed with a conventional aluminum alloy, but given a structural strength capable of withstanding 18 G's—far more than the body of any pilot could tolerate. There was also a slender, tapering midwing and a fairly conventional tail. The X-1 had a retractable landing gear, but from the beginning it was planned for a launch at altitude from a "mother plane," since the four-burner rocket engine could burn for only 2.5 minutes at full power. It was designed for a power-off, fuel-evacuated landing.

The airplane weighed about 6,800 lbs. empty but carried more than its own weight in fuel—a mixture of liquid oxygen, water and alcohol. Compressed nitrogen was used

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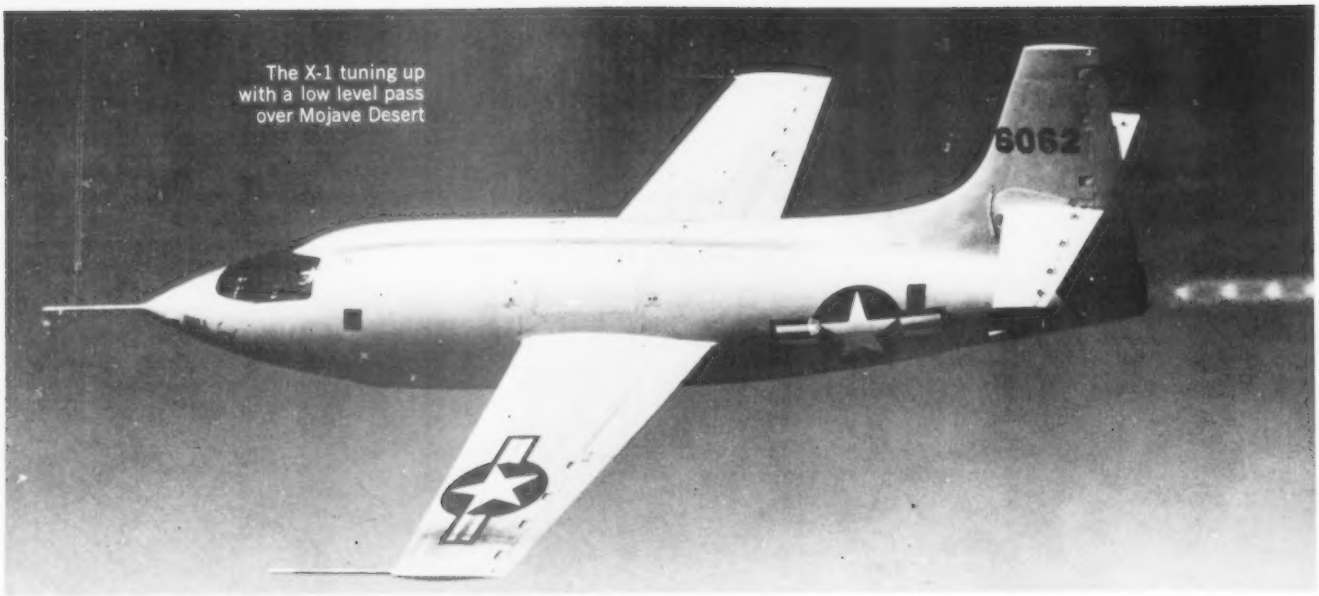


The X-1 tuning up with a low level pass over Mojave Desert

for cabin pressurization and for all auxiliary power, including flaps and landing gear motors, flight instruments and controls. Controls were conventional except for four igniter switches that replaced throttles. The pilot could start or stop any of the four 1,500 hp rockets at will—as long as the fuel lasted. *The X-1 stalled at 240 mph.*

For nearly 6 months Chuck Yeager lived and labored with the X-1, studying it, discussing it with the scientists in the program, flying it, cautiously at first at moderate speeds, testing its control response, performing rolls, spins and every acrobatic trick known to veteran fighter pilots—with Bob Hoover in a P-80 futilely chasing him over the desert skies. The test center was at Muroc Dry Lake, near Lancaster, Calif. Gradually Chuck eased the X-1 up toward the speed of sound, backing off whenever the buffeting became too intense, experimenting continuously to find some means of retaining control, suggesting modifications in the design, testing again, discussing again . . . . He came to love the airplane, calling it "the best damn plane I ever flew," and yet the shadow of doubt was always there, for the day when he would have to put his knowledge, his experience and his faith to the final test. The barrier had to be breached.

That day came on October 14, 1947—a Monday. The Friday before, Yeager finished his final preparations, knocked off work early, drove home in his ancient Model A flivver and had a quiet supper with his family. That evening, to help him unwind, he and Glennis went for a moonlight horseback ride over the desert dunes. He could not discuss the X-1 project with her—all she knew was that he "tested various airplanes . . ." but she sensed that something heavy was on his mind, and he needed companionship. After riding for hours they came racing back to the corral, with a thoroughly relaxed Yeager in the lead. At the last moment—too late to swerve—he realized that the corral gate had been closed. His horse slammed into the gate, throwing him off. Yeager got up with a reassuring grin, but by the next morning he was in obvious pain.

He balked at the idea of going to the base hospital, knowing that if anything at all was wrong he would be taken off the Monday morning demonstration test flight—after his months of work and strain and infinite preparation that honor would go to someone else! He had become so closely identified with the X-1's mission that it seemed almost a personal challenge, a private matter between him and one of nature's most stubbornly guarded secrets: *was there a limit to the soaring ambitions of human flight?*

And yet he was soldier enough not to let his own ambition lead to possible failure for the X-1, in the event he was seriously incapacitated. In civilian dress he drove his Model A to Rosamond, 15 miles away, and had a private doctor examine him. The verdict: two broken ribs, no internal damage. He was taped heavily, counseled not to undertake any strenuous activity for a while, and sent home, happy. He would still fly the mission.

On Monday morning Yeager checked over the X-1 one last time as the bright orange rocket plane, dubbed the "Glamorous Glennis," was clamped into the bomb bay area of a B-29 and fueled. Hanging half in and half out of the big four engine bomber, the X-1 was carried aloft 10,000 feet before the pilot boarded from the bomb bay, climbing gingerly down a ladder while bucking the B-29's 200 mph slipstream, working his way in feet first through the side entry hatchway. The hatch itself was then lowered for the pilot to lock in place. The hatch could not be opened in flight—*there was no ejection device, no way out except to bring the plane down onto the gleaming desert sand.*

On this particular day, because of his broken ribs and taped ribcage, Yeager was unable to reach far enough to close the lower lock bolts on the hatch, but an engineer in whom he confided had thoughtfully provided him with a two foot section of broom handle, and this primitive instrument enabled Yeager to secure the ultra sophisticated, multi-million dollar test plane for flight.

At 25,000 feet the B-29 pilot gave Yeager a countdown and cut him loose. Yeager switched on three rocket engines and put the X-1 into a climb. He knew that all previous attempts to crack the sound barrier had involved prop planes or subsonic jets that were dived to achieve Mach 1. It seemed likely that moving from thinner to denser air would increase the intensity of the shock waves and subsequent extreme buffeting. To avoid problems of this nature Yeagear leveled the X-1 at 38,000 feet before he cut his last rocket engine.

He began to experience fairly heavy buffeting at Mach .8, which increased as the Mach speed crept up to .87, then .90, then .94. On earlier flights at this speed the elevator would flop loosely with no response at all, but by trial and error Yeager had learned how to retain pitch control by changing the angle of incidence of the horizontal stabilizer, which could be done in-flight by means of an air-driven motor. This had enabled him to reach Mach .96. The question remained: would increased inci-

dence retain control through Mach 1?

With his 2.5 minutes of total powered flight time nearing an end, he could not hesitate to learn the answer. He lowered the nose of "Glennis" slightly and watched the speed move up to Mach .97, then .98, and on up. The buffeting ceased suddenly and the Machometer told Yeager what he had already guessed—he had surpassed the speed of sound, he had penetrated that hypothetical brick wall. There was no longer a speed limit in the sky.

Yeager went on to break the sound barrier many times, in the X-1 and in the X-1A, whose more powerful rockets developed 10,000 hp and could burn for a full 4.5 minutes. On this very last flight he took the X1-A up to 80,000 feet and achieved an incredible Mach 2.5 before burnout. At this point the aircraft yawed out of control and commenced in a series of wild gyrations, culminating in an inverted spin. Yeager was experiencing a gravity pull of 9 G's, and to add to his problems the face mask of his pressure suit became clouded over from his high breathing rate. His head slammed against the control stick, resulting in a violent snap roll and a temporary blackout. "I figured the tail had come off. If I had any way of getting out of the airplane I would have. . . ."

He collected himself, pulled the X-1A out of the spin at 25,000 feet and glided down to the dry lake bed for a smooth landing. The only damage to the rugged plane was loss of the canopy. The pilot suffered only a scolding from the manufacturer, who told him, "You were flying the airplane too fast and had a loss of stability about all three axes."

Yeager continued his career as a test pilot and tactical commander, amassing over 10,000 flight hours in some 140 different aircraft by the close of the Vietnam war. He retired hale and hearty, as a Brig. General in 1975, to a relaxed life of riding, hunting and fishing and occasional aviation consulting. He still enjoys flying "any kind of plane I can get my hands on." He has the satisfaction of knowing that the lessons he learned in the solitude of the X-1's cockpit over the Mojave Desert helped open the door to unlimited exploration of seemingly endless space. *Not bad, for a country boy from West Virginia.*

## BRIEFS

Pilots are cautioned that they are not doing their flying friends any favors by handing down to them outdated en route charts and approach plates. Obsolete charts in the hands of a pilot flying IFR could be extremely dangerous. (The same is true of sectionals, to a lesser extent.) When new charts come in, pilots are advised to install them in place at once, destroying the old ones to avoid any possible confusion.

Propeller and rotor injuries and fatalities continue to be reported at a rate almost identical to that of pre-World War II days—one every 17 or 18 days on an average. In an effort to reduce the rate of these almost totally preventable accidents. FAA has expanded its advisory circular on the subject, and included the hazards of helicopter rotors as well as propellers. Also added is a paragraph on painting blades to increase their conspicuity. Request "Hazards of Rotating Propeller and Helicopter Rotor Blades" (AC 91-42A).

the new name for AUDUBON INTERSECTION, that is. Furthermore APPLE SPRINGS has now become JUICE and WOODS HOLE has become WORMY, as FAA phases in a new system of converting all intersection and waypoint names to five-letter pronounceable code names that can be used for both charting and computer purposes. Under the old system fixes were often named for local topography or towns, while a separate three-letter code was used for computer purposes. The new method, which is designed to reduce chart clutter and simplify the system, will be accomplished in stages to minimize the impact on users and chart producers.

If the snow and ice removal program at your airport is less than effective, you will be interested in a new FAA advisory circular that provides guidance on setting up such programs. Included is data on snow removal equipment and materials, a detailed sample snow removal plan, and suggestions for forming a "Snow Committee" with delegated responsibilities for the various members. Snow, slush and ice on airports is often a factor in aircraft accidents: a two-year total of general aviation accidents included 317 with these elements as a cause factor. AC 150/5200-23, "Airport Snow and Ice Control" is free.

and its maintenance, as required by FAR Part 135 Air Taxi rules, is the subject of an updated FAA Advisory Circular. Although the FARs do not prescribe specific rules for maintenance and test of oxygen pressure cylinders, they do require maintenance in an "approved manner". Air Taxi operators wishing to submit a maintenance program for approval should contact their certificate holding district office before developing such a program. Further details can be found in "Maintenance Program Approval For Carry-On Oxygen Equipment for Medical Purposes", AC 135-5A.

Advisory circulars mentioned are available free from DOT/FAA Distribution Unit, TAD 443.1, Washington, D.C. 20590.

80 OCTANE IS COMING BACK. The EXXON Corporation has announced that it is reinstating production of Grade 80 (80 octane) aviation gasoline. At press time they were still canvassing their 600 dealers of aviation fuel to determine who will store and distribute the Grade 80 fuel. (Check with your supplier for this information.)
Charles Stone, Technical Aviation Adviser for EXXON advised FAA that EXXON will continue its research on Grade 100 low lead gasoline in an attempt to determine what chemical actions are occurring that have created increased aircraft engine maintenance and what steps can be taken to reduce valve problems and spark-plug fouling.

# Substantial General Aviation Growth Predicted

The general aviation fleet is expected to grow at an annual rate of four percent over the next twelve years, according to a recently released FAA forecast, which projects some 267,000 general aviation aircraft in 1988, up from the 1976 total of 168,500. General aviation hours flown will increase at an even faster rate of six percent per year.

A substantial rise in air taxi operations is also seen—6.9 million in 1988, as opposed to 2.9 million in 1976. During the same period, U.S. airline passengers are expected to more than double, going from 195.1 to 393.2 million. Operations at air traffic facilities will show related increases.

FAA's forecast assumes moderate economic growth with declining but still relatively high unemployment, and inflation rates at about six percent. It also assumes energy and fuel supplies will not significantly inhibit aviation growth, although prices are expected to increase.

Copies of the report, "Aviation Forecasts—Fiscal Years 1976-1988", are available to the public through the National Technical Information Service, Springfield, Va. 22151.

# Noise Rule Would Limit Use of Ag Planes, Firefighters

New noise rules proposed by FAA would limit operation of propeller-driven small airplanes designed for agricultural flying and firefighting to the purpose for which they were meant.

FAR 36 currently prescribes noise standards (including noise testing) for all propeller-driven small airplanes, except those designed for agricultural operations or for dispensing fire fighting materials. Most such aircraft are automatically limited in operation because they are certificated in a restricted category. Some, however, may be certificated in the standard classification. The new rule would assure that if these aircraft did not meet the noise standards, they could not be used, other than for their designed purpose.

Comments on the proposal (Notice #76-21) should be submitted in duplicate by February 28, 1977, to FAA Rules Docket, AGC-24, Washington, D.C. 20591.

# Aircraft Effect on Ozone Studied

In an effort to determine what effect high-flying aircraft may have on the earth's protective ozone layer, FAA has contracted for a study to measure oxides of nitrogen—present in all aircraft engine emissions—and ozone in the stratosphere. The one-year measurement program, to be conducted by York University of Ontario, Canada, will begin next spring in cooperation with the National Oceanic and Atmospheric Administration's Aeronomy Laboratory in Boulder, Colo.

Measurements will be made by lofting detection instruments in balloons to a height of 22 miles. The study—part of FAA's High Altitude Pollution Program—will involve the first simultaneous measurement of these constituents, an important step in understanding their role in maintaining the ozone balance.

# Glider Test Guide Updated

A new FAA Written Test Guide is available for private and commercial glider pilot applicants seeking certification under FAR Part 61 (Revised). The 36-page booklet contains a comprehensive study outline and a list of recommended study materials and explains how these publications can be obtained. It also includes study questions and illustrations pertinent to the subject of glider flying.

AC 61-81, "Private and Commercial Pilot, Glider, Written Test Guide" is sold for $1.00 by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Include self-addressed mailing label with order.

# Microwave Landing Systems

The Microwave Landing System (MLS) Advisory Committee charter has been renewed for another two years. The Committee, which has been in existence since 1971, is composed of technical experts and representatives of aviation user groups and government (FAA, NASA and military).

Microwave landing systems differ from existing systems in that they use a higher frequency wave length (50 times higher than most existing systems), which permits focusing radiated energy in a narrower beam. Advantages of MLS include reduced environmental interference, more dependability, greater acceptance rates at airports, greater precision, and more flexibility (pilots can choose their own glide slope approaches, including horizontally curved courses). First MLS installations are expected in the early 80's, after which there will be a period of at least ten years when both MLS and the present ILS system will be available.

## • Cheers

I thought it was time I expressed my opinion about your publication, FAA General Aviation News. I think it is a superbly put-together, well-written, and very pertinent magazine. With better than 3,000 hours of experience, I still find useful tips on maintenance and flying techniques in almost every issue, and I think it should be "required reading" for all general aviation pilots.

William J. Fried
Westbury, N.Y.

## • Pilot-in-Control?

Because of the many areas of confusion resulting from various uses of the term "pilot-in-command", I would like to suggest we stick to the definition in FAR 1.1, namely the one "responsible for the operation and safety of an aircraft". I then propose that a new term be created, such as "pilot-in-control", which would refer to the person actually manipulating the controls of the aircraft during operation. The latter term could be used for logging time and pilot certification purposes.

I think this could result in a welcome simplification for all of us.

John V. Kjellman
Mountain View, Calif.

*Thank you for your suggestion. It will be considered for possible inclusion in the review of Part 61 of the FARs which is tentatively scheduled in the first quarter of calendar year 1977.*

## • Separate Logs?

I would like to know if a mechanic would be in violation (in case of a subsequent accident or incident) for not recording an annual inspection in the engine logbook, even though he did so in the aircraft log?

K. W. Clary
Houston, Texas

*The mechanic is not in violation of the rules if he enters the annual inspection only in the aircraft maintenance logbook, since this inspection is required by regulation to include the engine (thus a single signoff indicates the engine has been inspected).*

*However, the* aircraft owner/operator *is required by FAR 91.173 to keep maintenance records for "each aircraft (including the airframe) and each engine, propeller, rotor and appliance of an aircraft." Furthermore, he is required to pass on the pertinent maintenance record when any of these items, such as the engine, is disposed of. For those reasons we suggest that aircraft owners keep separate records for these various items, and that they have their mechanic make annual inspection entries in each logbook that is kept. And we recommend that mechanics, in the best interest of their customers, make the entries in this manner.*

## • Convicted Felon

Are there any cancellations, restrictions, or complications with regard to pilot licenses, or ratings for resumption of a flying career by a former pilot convicted of two felonies?

Name withheld
Portland, Oregon

*It depends on the charge. The Federal Aviation Regulations do not contain character requirements as conditions for pilot certification, except for airline transport pilot. However, persons convicted of violations related to narcotic drugs, marijuana, depressant or stimulant drugs (including growing, processing, manufacture, sale, disposition, possession, transportation or importation) may not be issued a certificate for a year after the date of final conviction. Also, any conviction relating to narcotic drugs as listed above can cause revocation of a certificate. In addition, medical examinations are required for pilot certificates (except for gliders and balloons) and persons with established histories of burglary theft, rape, etc., often have personality disorders which may prevent them from meeting medical standards.*

## • The Truth About September

Your October 1976 issue contained a fine article titled "Returned to Service". In it you mention that the first half of the article appeared in the September issue. However, I recall getting a "special notice" in the mail indicating that the September issues had been destroyed.

If this is true, do you intend to reprint the September issue including the above mentioned article? I hope so; I count on your monthly "words of wisdom".

D. G. Warner
Rochester, N. Y.

*The notice that some subscribers received, stating that the September magazine would not be issued, was sent in error by the Government Printing Office during the confusion following a fire that did indeed destroy the original print run of that issue. The September magazine was reprinted shortly thereafter and should have reached you by mid October. The normal October issue should have arrived late in October or early in November. The two maintenance articles you mentioned are being combined in a special reprint that will soon be available locally through the FAA Accident Prevention Program.*

## • The Experts Disagree

Some local aviation "experts" whose opinion I normally respect completely disregard your answer to the July 1975 question regarding flight instructors and private pilots concurrently logging pilot-in-command time. They feel your publication is not an "official" document and should be, in some cases, disregarded. While we respect these people, we are also avid readers of this well-written magazine and trust its validity. Tell us, should we take your articles with a grain of salt?

Name withheld

*It is true that this magazine, including the "Flight Forum", is "advisory or informational" rather than "regulatory". However, the answer to this particular question was cleared through FAA's Flight Standards Service prior to publication, and is correct in that both the pilot receiving instruction and the instructor can log pilot-in-command time in accordance with the quoted regulations.*

**FAA GENERAL AVIATION NEWS** welcomes comments from our readers. No anonymous letters will be used, but names will be withheld on request. Address: FAA GENERAL AVIATION NEWS, AFS-807, Washington, D.C. 20591.

## • POMOLA

Regarding the "Poor Man's VASI" mentioned in the September "Forum", my first experience with this system was in 1965 in Beeville, Tex. as a Navy pilot flying F-9 *Cougar* jets. We called these "Pamola Boards" and used them for glidescope reference. Does anyone know what "Pamola" stands for, and who actually invented the system?

Carl Dinwiddie
Philipsburg, Pa.

*Information gathered from the numerous letters we have received on this subject since it was first mentioned in our magazine indicate that these three-board VASI's have been around since at least the 50's when they were used by the Navy for carrier landing practice. The name most often mentioned is "POMOLA" (rather than PAMOLA), acronym for "poor man's optical landing aid". We have not heard who originally invented the system.*

## INSTRUMENT CORNER

## • RVR vs. Visibility

Would you please explain the difference between "runway visual range" (RVR) and "visibility" as used in terminal weather reports. Also, how do RVR figures apply to approach minimums if the latter are listed in miles?

J. J. Jones
Baltimore, Md.

*RVR represents the horizontal distance a pilot of a moving aircraft should see looking down the runway from the approach end. RVR is based on the measurement of a "transmissometer" made near the touchdown point of the instrument runway, and is reported in hundreds of feet.*

*Prevailing visibility, on the other hand, is a visually derived value, defined as "the greatest distance objects can be seen and identified through at least 180 degrees of the horizon." It is reported in statute miles and fractions.*

*For situations where an RVR report is given for a runway, but the minimums for a specific approach are listed in visibility miles rather than RVR values, the following table applies:*

| RVR | Visibility in Statute Miles |
|---|---|
| 1600 feet | ¼ mile |
| 2400 " | ½ " |
| 3200 " | ⅝ " |
| 4000 " | ¾ " |
| 4500 " | ⅞ " |
| 5000 " | 1 " |
| 6000 " | 1¼ " |

*A new FAA Advisory Circular discusses RVR in greater detail. "Runway Visual Range (RVR)", AC 97-1, is available free from DOT/FAA Distribution Unit, TAD 443.1, Washington, D.C. 20590.*

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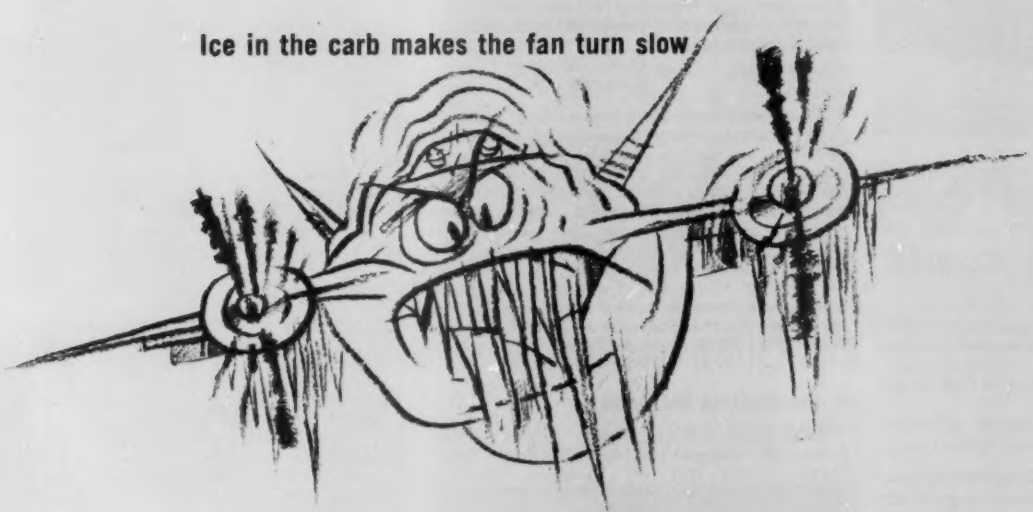


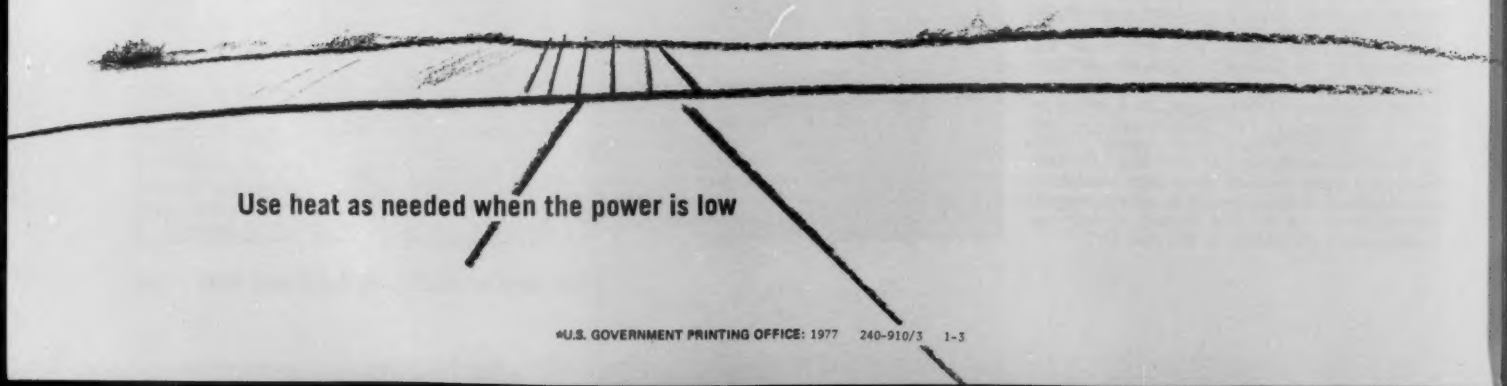


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